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MOTOR CONTROLLER  
[Mota Seigyo Sochi]

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## 1. Title

Motor Controller

## 2. Claims

(1) A motor controller comprising: a speed setter that sets the target speed of a motor; a comparator that outputs, as the speed command, the difference between the aforesaid target speed and the angular velocity of the motor; an amplifier that amplifies the aforesaid speed command; a pulse-width controller that is connected to the aforesaid amplifier and a power source and that controls the pulse width in response to the speed command; a motor that rotates in proportion to the power of the pulse-width modulated pulse and that also drives a load; and a counterelectromotive force detector that detects the counterelectromotive force of this motor and feeds it to the comparator,

wherein a closed loop is formed by means of the aforesaid counterelectromotive force detector, and the counterelectromotive force of the motor is utilized as the angular velocity signal of the motor for controlling the motor speed.

(2) The motor controller stated in Claim 1, wherein the aforesaid counterelectromotive force detector comprises a sampling circuit, peak hold circuit, and filter circuit.

## 3. Detailed Description of the Invention

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\* Number in the margin indicates pagination in the foreign text.

The present invention pertains to a motor controller that causes a motor to drive a load and performs speed control.

First, referring to Figs. 1 and 2, the following will explain a conventional motor controller of this type.

In Fig. 1, reference numeral 1 indicates a speed setter; 2, a comparator; 3, an amplifier; 4, a power source; 5, a pulse-width controller; 6, a motor; and 7, an angular-velocity detector.

Incidentally, for simplifying the explanation, it is assumed here that the power source (4) is a DC power source, and the angular-velocity detector (7) is a tachogenerator.

With the controller thus configured, the speed setter (1) can set the target speed of the motor (6) arbitrarily and outputs the target speed voltage. The comparator (2), upon receiving the aforesaid target speed voltage and the output voltage of the angular-velocity detector (7), compares them and feeds the voltage difference to the amplifier (3) as the speed command, and the amplifier (3) amplifies the speed command and feeds it to the pulse-width controller (5). The pulse-width controller (5) chops the output voltage of the DC power source (4), modulates the pulse width according to the amplified speed command, and feeds it to the motor (6). Here, the pulse-width controller (5) carries out a control in such a manner that, as the speed command becomes larger, the pulse width becomes longer. The motor (6) rotates in proportion to the mean value of the power of the pulse-width modulated pulses. Meanwhile, the angular-velocity detector

(7) is capable of rotating in sync with the rotation of the motor (6) because it is connected to the rotary shaft of the motor (6) by means of a shaft or the like; therefore, the angular-velocity detector (7) outputs a voltage that is proportional to the angular velocity of the motor (6) and feeds it to the comparator (2).

This configuration makes it possible to control the rotation speed of the motor (6) so that there will be no difference between the output voltage of the speed setter (1) and the output voltage of the angular-velocity detector (7), that is to say, the setup speed of the speed setter (1) and the rotation speed of the motor (6) will become the same.

Fig. 2 illustrates the operation waveform of each component of this conventional motor controller. (a) is the output voltage waveform of the speed setter (1) and indicates the target speed that is set arbitrarily. (b) is the output voltage waveform of the pulse-width controller (5) that has been subjected to pulse width modulation in response to the speed command. (c) is the output voltage waveform of the angular-velocity detector (7), and it is a voltage proportional to the angular speed of the motor (6).

As described in the foregoing, the conventional motor controller is configured to control the motor (6) stably by detecting the angular speed by means of the angular-speed detector (7) and by feeding it back and thereby forming a closed circuit.

The conventional motor controller, however, requires the installation of a dedicated angular-velocity detector (7) on the rotary shaft of the motor (6) in order to detect the angular velocity of the motor (6) separately from the motor (6). This causes the controller structure to become large and also leads to high cost, and it also gives rise to problems, such as the need for maintenance and so forth.

The objective of the present invention is to solve these problems of the conventional controller, and it is characterized by the fact that it implements the speed control not by using the angular-velocity detector (7) but by utilizing the counterelectromotive force of the motor (6), which is a voltage that is equivalently proportional to the angular velocity of the motor (6).

The following will explain one embodiment of the present invention, referring to Figs. 3, 4, and 5. Fig. 3 illustrates an example of the structure of the motor controller according to the present invention, and Fig. 4 shows in detail an example of the structure of the counterelectromotive force detector (8) shown in Fig. 3. In Fig. 3, reference numeral 1 indicates a speed setter; 2, a comparator; 3, an amplifier; 4, a power source; 5, a pulse-width controller; 6, a motor; and 8 a counterelectromotive force detector.

In Fig. 4, reference numeral 9 indicates a sampling circuit; 10, a peak hold circuit; and 11, a filter circuit.

Fig. 5 shows the waveform of each component of the motor controller according to the present invention. (a) shows the output voltage waveform of the speed setter (1); (b), the output voltage waveform of the pulse-width controller (5); (d) [Translator's note: there is no (c)], the counterelectromotive force waveform of the motor (6), that is to say, a voltage waveform proportional to the angular velocity of the motor (6); (e), the output voltage waveform of the sampling circuit (9); (f), the output voltage waveform of the peak hold circuit (10); and (g), the output voltage waveform of the filter circuit (11).

With the motor controller of the present invention, the speed setter (1) can set the target speed of the motor (6) arbitrarily, and the speed setter (1) outputs the setup voltage, like the one shown in Fig. 2 (a). The comparator (2), upon receiving the aforesaid target speed voltage and the output voltage of the counterelectromotive force detector (8), compares them and feeds their voltage difference to the amplifier (3) as the speed command. The amplifier (3) amplifies the speed command and feeds it to the pulse-width controller (5). The pulse-width controller (5) chops the output voltage of the DC power source (4), modulates the pulse width according to the amplified speed command, and outputs a pulse train, like the one shown in Fig. 2 (b). The motor (6) is rotated by the output voltage of the pulse-width controller (5) and drives a load. Here, the composite voltage of the output voltage of the pulse-width controller (5) on the input side of

the motor (6) and the counterelectromotive force of the motor (6), like the one shown in Fig. 2 (d), is input to the counterelectromotive force detector (8). The counterelectromotive force detector (8), as shown in Fig. 4, is constructed from a sampling circuit (9), peak hold circuit (10), and filter circuit (11). The sampling circuit (9) samples during a short time that is in sync with the time between the pulses output by the pulse-width controller (5), that is to say, during the time in which only the counterelectromotive force of the motor (6) is present, and Fig. 2 (e) shows this sampling voltage waveform. The peak hold circuit (10), as shown in Fig. 2 (f), holds the peak of the sampling voltage, and, upon passing through the filter circuit (11), this sampling voltage becomes a smooth voltage waveform, as shown in Fig. 2 (g). The output voltage of this filter circuit (11) is the counterelectromotive force of the motor (6); thus, the counterelectromotive force detector (8) can take out the counterelectromotive force of the motor (6) alone from the composite voltage on the input side of the motor (6). As explained before, the counterelectromotive force of the motor (6) is a voltage that is equivalent to the output voltage of the angular-velocity detector (7) of the conventional controller and that is proportional to the angular velocity of the motor (6); therefore, by feeding the output voltage of the counterelectromotive force detector (8) to the comparator (2), the feedback control of the motor (6) speed can be realized, as in the conventional example. /3

Incidentally, the explanation of the present invention in the foregoing relates to the case of using a DC power source as the power source (4), but, not limited to this, the present invention may use an AC power source, in which case the pulse-width controller (5) may be comprised of a thyristor Leonard system.

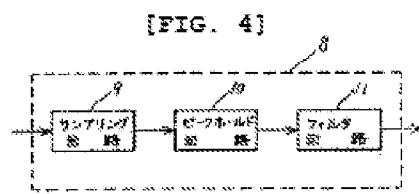
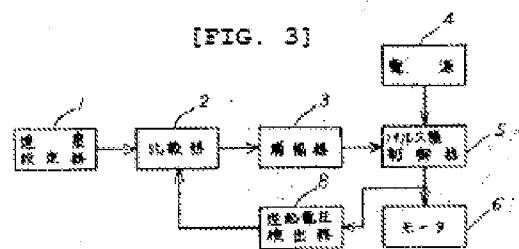
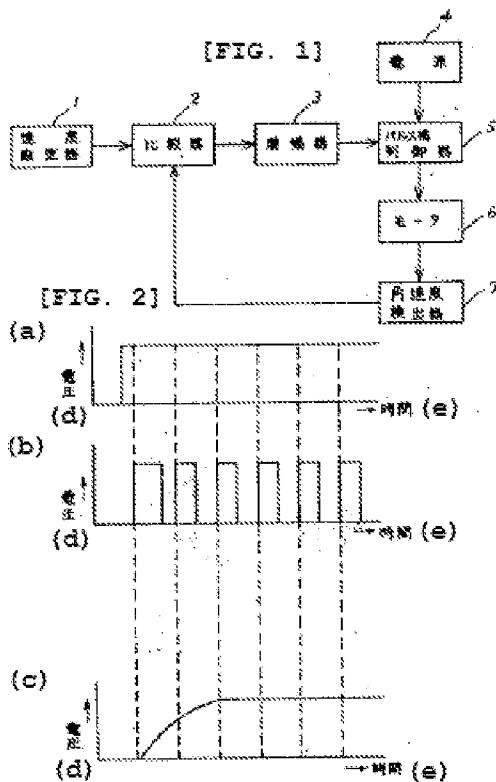
As explained in the foregoing, because the motor controller pertaining to the present invention can control the speed of a motor (6) utilizing the counterelectromotive force of the motor (6), without using an angular-velocity detector (7), it has advantages in that it is less expensive and smaller than the conventional type and also in that its maintenance is simpler.

#### 4. Brief Explanation of the Drawings

Fig. 1 is a structural diagram of the conventional motor controller. Fig. 2 shows the operation waveforms of the conventional motor controller. Fig. 3 is a structural diagram of the motor controller according to the present invention. Fig. 4 is a structural diagram of the detector for the counterelectromotive force of the motor. Fig. 5 shows the operation waveforms of the motor controller of the present invention.

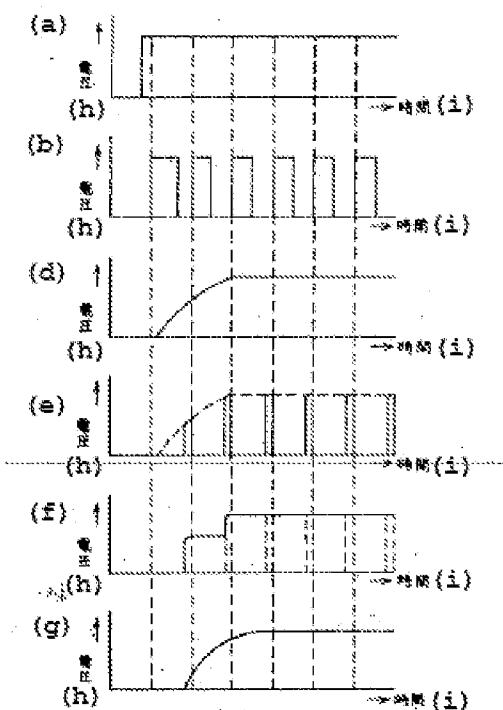
In the figures, reference numeral 1 indicates a speed setter; 2, a comparator; 3, an amplifier; 4, a power source; 5, a pulse-width controller; 6, a motor; 7, an angular-velocity detector; 8, a counterelectromotive force detector; 9, a sampling circuit; 10, a peak hold circuit; and 11, a filter circuit.

In the figures, the identical or like parts are given the same reference numerals.



Key: d) voltage; e) time

[FIG. 5]



Key: h) voltage; i) time